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ध्वनि तंत्र उपस्कर

भाग 2 सामान्य परिभाषाओं एवं परिकलन विधियों की व्याख्या

Indian Standard

SOUND SYSTEM EQUIPMENT

PART 2 EXPLANATION OF GENERAL TERMS AND CALCULATION METHODS

ICS 33.160.01

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

September 2005 **Price Group 7**

Acoustics and Recording Sectional Committee, LTD 5

NATIONAL FOREWORD

This Indian Standard (Part 2) which is identical with IEC 60268-2 (1987) 'Sound system equipment — Part 2 : Explanation of general terms and calculation methods' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendations of the Acoustics and Recording Sectional Committee and approval of the Electronics and Information Technology Division Council.

This standard supersedes IS 9302 (Part 2) : 1979 and has been brought out to align with latest IEC Standard on the subject and also with the practices being followed in the country.

This standard will form part of a series of standards. Other parts of the series are given below:

(Part 1)	General
(Part 3)	Amplifiers
(Part 4)	Microphones
(Part 5)	Loudspeakers
(Part 6)	Auxiliary passive elements
(Part 7)	Headphones and earphones
(Part 8)	Automatic gain control devices
(Part 9)	Artificial reverberation, time delay and frequency shift equipment
(Part 10)	Peak programme level meters

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Amendment No. 1 to the above International Standard have been printed at the end of this publication.

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard.

IS 15596 (Part 2) : 2005
IEC 60268-2 (1987)

Indian Standard

SOUND SYSTEM EQUIPMENT

PART 2 EXPLANATION OF GENERAL TERMS AND CALCULATION METHODS

For the purpose of this standard, the following explanations of general terms and calculation methods apply:

1. General terms

1.1 *Sound system*

An assembly of equipment which in combination enables sound signals or audio-frequency signals to be processed or transmitted.

Such equipment may be, for example, transducers, amplifiers, recorders, etc.

1.2 *Compatibility*

A component of a system is said to be compatible with another component if, when they are connected together, satisfactory operation is obtained.

1.3 *Variable consumption apparatus*

An apparatus in which the power drawn from the supply system may vary significantly during operation, as a function of the signal or the load impedance or of the control settings (excluding power supply switches).

Note. – For some purposes, changes of less than 15% may be insignificant.

1.4 *Noise signal*

A stationary random signal having normal probability distribution of instantaneous values. Unless otherwise stated, the mean value is zero.

Note. – This explanation applies to noise signals used for testing. Noise as an unwanted signal is considered in Clause 6.

1.4.1 *White noise signal*

A noise signal whose energy per unit bandwidth $\left(\frac{\Delta W}{\Delta f}\right)$ is independent of frequency.

1.4.2 *Pink noise signal*

A noise signal whose energy per unit bandwidth $\left(\frac{\Delta W}{\Delta f}\right)$ is inversely proportional to frequency.

1.4.3 *Broadband noise signal*

A noise signal, band-limited by means of a filter with defined amplitude/frequency response whose bandwidth is greater than that of the equipment under test.

Note. – A broadband noise signal may be a band-limited white or pink noise signal, or have some other defined power spectrum.

1.4.4 *Narrowband noise signal*

A noise signal, band-limited by means of a filter with defined amplitude/frequency response, whose bandwidth is small compared with that of the equipment under test.

1.5 *Rated values*

In this standard, the term "rated value" is used in a particular sense. Wherever it is used it means "the value stated by the manufacturer". The word "rated" has this meaning even though it is used in terms such as "rated conditions" or in the name of a characteristic.

1.5.1 *Rated conditions*

When an equipment is to be used or tested it has to be operated under certain conditions which are fixed by the manufacturer. These conditions include electrical, mechanical and climatic conditions, and they cannot, by their nature, be verified by measurement.

Rated conditions for a particular type of equipment generally include some or all of the following:

- *Electrical*
  - Rated power supply voltage(s)
  - Rated power supply frequency
  - Rated source impedance(s)
  - Rated source e.m.f.(s)
  - Rated load impedance(s)
- *Mechanical*
  - Mounting position
  - Ventilation
- *Climatic*
  - Rated ambient temperature ranges for operation and for full performance to specification
  - Rated relative humidity range
  - Rated air pressure range

Note. – Ranges are defined by the extreme values, each of which may be regarded as a separate rated condition.

1.5.2 *Rated value of a characteristic*

In IEC Publication 268, methods of measurement are given for a large number of characteristics. For each of these characteristics the manufacturer is required or permitted to state a value in the specification of equipment.

This stated value is, by definition, the rated value of that characteristic (see Sub-clause 1.5). The use of the term "rated" in this sense is not restricted to a limited set of major characteristics but may be applied to any characteristic for which a method of measurement is given. Since the rated value is the value stated by the manufacturer, the defining title of the "characteristic to be specified" does not, in general, include the word "rated"; the rated value is not something which is measured but is decided by the manufacturer taking into account measurements on many samples of the equipment and theoretical tolerance calculations.

For example, a method of measurement is described in IEC Publication 268-3 for the distortion-limited output power of an amplifier. The rated distortion-limited output power is the value stated by the manufacturer, usually calculated from measurements (according to the standard method) on several samples of the amplifier, supplemented by tolerance calculation.

Note. – Applies to French text only.

1.5.3 *Interdependent characteristics*

It often happens that the value of one characteristic is required to be stated for a particular value of another characteristic. An important example is the distortion-limited output power of an amplifier, which is stated for a particular value of total harmonic distortion. In this case it is necessary to adopt one of the characteristics as a rated condition, and it is preferable to adopt that characteristic whose rated value is either specified as a reference value in a relevant IEC standard or is chosen by the manufacturer more or less arbitrarily within certain practical limits.

1.5.4 *Matching values*

A knowledge of the values of certain basic characteristics of two items of equipment, which are to be connected together, is necessary in order to ensure compatability. These values are known as matching values and are stated by the manufacturer for conditions defined in the relevant parts of the standard. Some matching values are also rated conditions.

2. **Power**

2.1 *Relative power level*

Ten times the logarithm to base ten of the ratio of two powers under consideration, P_2 and P_1 respectively. The level L, expressed in decibels, is calculated as follows:

$$L = 10 \lg \frac{P_2}{P_1} \text{ dB}$$

2.2 *Power level*

Ten times the logarithm to base ten of the ratio of the power under consideration P to a reference power P_{ref}. The reference power may be 1 W or 1 mW.

According to the reference power chosen, 1 W or 1 mW, the symbol dB(W) or dB(mW) is added to the formula as follows:

$$L \text{ (re } P_{\text{ref}}) = 10 \lg \frac{P}{P_{\text{ref}}} \text{ dB(W) or dB(mW)}$$

2.3 *Available power from the source*

The maximum power which a device is capable of delivering to its load. In the case of a source with e.m.f. E_s and internal resistance R_s, the available power is given by:

$$\frac{E^2_s}{4\,R_s}$$

The power delivered to the load has a maximum value equal to this value when the load resistance is equal to R_s.

In practice, in particular for amplifiers and devices including amplification, compatibility may require a load impedance which differs considerably from the internal resistance.

2.4 *Available power gain*

The ratio of the output power delivered by a device to its load, P_2, to the available power from the source to that device, P_1. It can be expressed:

– either, as a direct ratio $\frac{P_2}{P_1}$

– or, in decibels: $10 \lg \frac{P_2}{P_1}$

Notes 1. – The available power gain may be greater or less than one. In the latter case the term "power attenuation" may be used, expressed in decibels as a positive number.

2. – In order to avoid misunderstanding, the terms "power gain" and "power attenuation" should not be abbreviated to "gain" and "attenuation".

3. **Voltage**

3.1 *Relative voltage level*

Twenty times the logarithm to base ten of the ratio of two voltages under consideration, U_2 and U_1 respectively. The level L_U, expressed in decibels, is calculated as follows:

$$L_U = 20 \lg \frac{U_2}{U_1} \text{ dB}$$

3.2 *Voltage level*

Twenty times the logarithm to the base ten of the ratio of the voltage under consideration U to a reference voltage U_{ref} which shall always be stated.

The preferred reference voltage is 1 V, other reference voltages being 1 mV and 1 µV.

For telecommunications and broadcasting transmission, a reference voltage of 0.775 V is used.

In presenting voltage levels informally, a condensed notation is often convenient for identifying the reference voltage. According to the reference voltage used, for example 1 V, the appropriate symbol dB(V), is added to the formula as follows:

$$L_U \text{ (re } U_{ref}) = 20 \lg \frac{U}{U_{ref}} \text{ dB(V)}$$

As an illustration, one may designate the voltage level corresponding to 100 mV as −20 dB(V), −18 dB(0.775 V), +40 dB(mV), +100 dB(µV).

3.3 *Voltage gain*

The ratio of the output voltage U_2 to the input voltage U_1. It can be expressed:

– either as a direct ratio: $G = \frac{U_2}{U_1}$

– or in decibels:

$$L_G = 20 \lg \frac{U_2}{U_1} \text{ dB}$$

Notes 1. – The voltage gain may be greater or less than one. In the latter case the term "voltage attenuation" may be used, expressed in decibels as a positive number.

2. – In order to avoid misunderstanding, the terms "voltage gain" and "voltage attenuation" should not be abbreviated to "gain" and "attenuation".

3.4 *E.M.F. gain* (overall voltage gain)

The ratio of the output voltage U_2 to the source e.m.f. It can be expressed either as a direct ratio or in decibels. Unless otherwise stated, e.m.f. gain is specified under conditions of maximum gain, and U_2 is equal to the value obtained under normal working conditions.

4. **Source e.m.f.**

4.1 *Equivalent source e.m.f.*

The e.m.f. of a source giving a sinusoidal signal of specified frequency which would produce an output signal, the r.m.s. value of which is equal to the r.m.s. value of the particular output signal under consideration.

If not otherwise stated, the frequency of the source e.m.f. shall be the standard reference frequency of 1000 Hz.

5. **Balance**

5.1 *Balanced circuits*

Detailed analysis of the behaviour of balanced circuits is complex and is not necessary for the specification of most elements used in sound systems. The characteristics and methods of measurement given in this standard are adequate to evaluate those unbalanced conditions which could cause interference problems in practical systems. To permit realistic comparison between the results obtained for different elements, it is inadvisable to depart from these procedures.

5.2 *Balanced inputs*

An input port is said to be balanced when the two input terminals have the same value of internal impedance with respect to a reference point and are intended to receive signals which are equal in magnitude but of opposite polarity with respect to that point. The reference point may be held at a fixed potential (either earth or a d.c. voltage for phantom feeding) or may be electrically isolated or even inaccessible. In the latter cases, the balanced input is said to be floating and the chassis (usually earthed) is used as the point of reference.

An essential requirement for balanced inputs is the efficient rejection of common-mode signals, that is, signals applied simultaneously to both terminals which, when measured with respect to the specified reference point, are identical in all respects.

The unbalance of an input port may be influenced by inequality of the internal impedances from the input terminals to the reference point and/or failure of the circuit adequately to reject common-mode signals. The combination of these effects is expressed as the common-mode rejection ratio (see Figure 1, page 11).

5.3 *Balanced outputs*

An output port is said to be balanced when the two output terminals have the same value of internal impedance with respect to a reference point and are intended to deliver equal voltage signals of opposite polarity with respect to the reference point. This point may be held at a fixed potential (usually earth) or may be electrically isolated or even inaccessible. In the latter cases, the balanced output is said to be floating and the chassis (usually earthed) is used as the point of reference.

The unbalance of an output port may be influenced by one or more of three effects:

1) Inequality of the internal impedances from the output terminals to the reference point.
2) Inequality of the e.m.f.'s at the output terminals with respect to the reference point. This effect is considered in terms of a common-mode signal superimposed on the wanted balanced signal.
3) Internal impedance of the source of unbalance. This is considered as the source impedance associated with the common-mode signal described in item 2 above.

The combination of these effects is expressed as the ratio of the balanced output signal to the common-mode signal. It should be noted that the measured value of common-mode voltage depends on the value of the resistor R_m (see Figure 2, page 11).

6. Noise

6.1 *Noise voltage*

The output voltage U'_2 of equipment operating under specified conditions with no wanted signal applied to the input. The specified conditions include the gain (or attenuation) of the equipment and the source and load impedances, if any.

The output voltage shall be measured by one of the methods given in Clause 6 of IEC Publication 268-1, the method used being stated.

6.2 *Signal-to-noise ratio*

Twenty times the logarithm to base ten of the ratio of a reference output voltage U_2 to the noise voltage U'_2 defined in Sub-clause 6.1. The method of measurement of U'_2 shall be stated. The reference output voltage U_2 shall be the rated distortion-limited output voltage unless otherwise stated:

$$20 \lg \frac{U_2}{U'_2} \text{ dB (wide band or weighted)}$$

6.3 *Equivalent noise source e.m.f.*

The e.m.f. of a source giving a sinusoidal signal of a specified frequency which will produce an output voltage equal to the noise output voltage produced.

Notes 1. – The frequency of the equivalent source should preferably be the standard reference frequency of 1000 Hz.

2. – This gives an example of equivalent source e.m.f.

7. Amplitude non-linearity

7.1 *Introduction*

Amplitude non-linearity in sound systems and sound system components causes signals to appear at the output which are not present in the input signal. The amplitude non-linearity is a function of other phenomena, for example frequency, amplitude and temperature and so is not constant, even when the signal amplitude is constant. There are several methods of assessing amplitude non-linearity; see Sub-clause 7.2. Spectrum diagrams showing the output spectra produced by these methods are given in Figure 3, pages 12 and 13.

7.2 *Explanation of terms*

1. *Amplitude non-linearity*
   Is the phenomenon through which frequencies appear at the output of a sound system or a sound system component, that are dependent on the characteristics of the input signal but are not present in it.
2. *Harmonic distortion* (see Figure 3a, page 12)
   Is the amplitude non-linearity expressed in terms of the ratio of the harmonics in the output signal to the total output signal when a sinusoidal input signal is applied. The signals may be expressed in terms of power, voltage or sound pressure.
3. *Harmonic distortion of the* n^{th} order (see Figure 3a)
   Is the harmonic distortion expressed in terms of the ratio of the r.m.s. output signal due to the component of harmonic order n, to the total r.m.s. output signal.
4. *Total harmonic distortion* (see Figure 3a)
   Is the harmonic distortion expressed in terms of the ratio of the r.m.s. output signal due to distortion, to the total r.m.s. output signal.
5. *Noise harmonic distortion*
   Is the harmonic distortion where ⅓ octave band filtered noise is used as the input signal.

   Note. – The term may be abbreviated to "noise distortion" if no confusion could be caused.
6. *Intermodulation distortion*
   Is the amplitude non-linearity expressed in terms of the ratio of the output signal of frequencies $pf_1+qf_2+\ldots$, (where p, q, ... are positive or negative integers), to the total output signal, when (at least two) sinusoidal input signals having the fundamental frequencies $f_1, f_2, \ldots$, are applied at the input. The signals may be expressed in terms of power, voltage or sound pressure.
7. *Noise intermodulation distortion*
   Is the intermodulation distortion where ⅓ octave band filtered noise is used as the input signal.
8. *Modulation distortion* (see Figure 3b, page 12)
   Is the intermodulation distortion where the input signal is composed of a large amplitude, low-frequency signal f_1 and a small amplitude, high-frequency signal f_2.

   Notes 1. – In some electroacoustical devices two kinds of modulation distortion are present, both having the same spectral components, differing only in phase:
   a) amplitude modulation distortion caused by the amplitude modulation due to non-linearity
   b) frequency modulation distortion caused by frequency modulation (e.g., Doppler effect in loudspeakers) having no relation to non-linearity.
   In such cases it is necessary to distinguish between these two types of distortion. If the simple term "modulation distortion" is used, amplitude modulation distortion is to be understood.

   2. – The reference output at which the distortion is considered to occur is taken as the arithmetic sum of the output signals at the frequencies f_1 and f_2.
9. *Modulation distortion of the* n^{th} *order* (see Figure 3b)
   Is the modulation distortion in terms of the ratio of the arithmetic sum of the r.m.s. output signals at the frequencies $f_2 \pm (n-1) f_1$ to the r.m.s. output signal at the frequency f_2.

10. *Total modulation distortion*

Is the modulation distortion in terms of the ratio of the total of arithmetic sums of the r.m.s. output signals (see modulation distortion of the n^{th} order) to the r.m.s. output signal at the frequency f_2.

11. *Difference-frequency distortion* (see Figures 3c and 3d, page 13)

Is the intermodulation distortion where the input signal is composed of two sinusoidal signals f_1 and f_2 of similar or equal amplitude, the difference in frequency of the two signals being less than the lower of the frequencies.

Notes 1. – The methods of expressing the various types of difference-frequency distortion are given in IEC Publication 268-3.

2. – The reference output at which the distortion is considered to occur is taken as the arithmetic sum of the output signals at the frequencies f_1 and f_2.

7.3 *Elucidation*

7.3.1 *Usage of the various methods*

The simplest method of assessing amplitude non-linearity is the measurement of harmonic distortion using a sinusoidal signal. A disadvantage of this method is, however, that the nature of the sinusoidal signal is different in some respects from the nature of a real sound signal and the fact that the amplitudes of the harmonic distortion products of some devices (such as loudspeakers) vary considerably with frequency in an irregular manner.

This latter difficulty may be partly overcome by measuring the "noise distortion", where a noise signal instead of a sinusoidal signal is used.

When measurement of harmonic distortion is not appropriate, or when further information on distortion is called for, intermodulation distortion measurements using sinusoidal or noise signals may be made.

7.3.2 *Correlation of results*

Though harmonic distortion and intermodulation distortion are both phenomena caused by amplitude non-linearity, it is not easy to correlate the results of different measurements. These types of distortion are interrelated by the device transfer-function, expressed as a power series and as a function of frequency. The derivation of the overall performance of a device from the measurement of only one form of distortion may be tedious, inaccurate and difficult, unless:

1) The transfer function curvature is known to be of low order.
2) The radius of curvature is not small.
3) The frequency dependence is negligible or, at least, well-defined by mathematically manageable equations.
4) There is no bandwidth limitation between any point where non-linearity occurs and the output of the device.

It is more practicable to perform comprehensive measurements than attempt calculations when these conditions are not fulfilled.

7.3.3 *Reference signals*

In order to allow a valid comparsion of the results of measurements carried out with different test signals, it is necessary to compare the amplitudes of the test signals in terms of their peak-to-peak values. When the test signal is not a single sinusoidal signal, the value of output at which a given amount of distortion occurs is therefore expressed as the r.m.s. value of a sinusoidal reference signal which has the same peak-to-peak value as the output due to the test signal would have, if it were not distorted.

Note. – Unless it is specifically intended to include hum, noise and components of the output signal not due to the input signal, care should be taken to ensure that they do not influence the accuracy of distortion measurements.

It should be noted that the necessary degree of freedom from non-linearity in sound systems or sound system components cannot at present be specified with certainty, but depends on the perception of the human ear, which can rarely perceive harmonic distortion of less than 0.1%.

8. Cross-talk and separation in multi-channel equipment

8.1 *General*

In multi-channel equipment, signals in one channel can break through into another channel in an attenuated and perhaps distorted form. The influence of a signal on another channel can be described in terms of cross-talk attenuation or separation.

8.2 *Cross-talk attenuation* (from A to B)

Twenty times the logarithm to base ten of the ratio of the rated output voltage of channel A, $(U_A)_A$, to the output voltage of channel B, $(U_B)_A$, due to the rated input voltage applied to channel A. The number of decibels is calculated as follows:

$$20 \lg \frac{(U_A)_A}{(U_B)_A} \text{ dB}$$

Note. – This characteristic may not be meaningful if the channels A and B are dissimilar in rated output voltage.

8.3 *Separation* (of A from B)

Twenty times the logarithm to base ten of the ratio of the rated output voltage of channel A, $(U_A)_A$, to the output voltage of channel A, $(U_A)_B$, due to the rated input voltage applied to channel B. The number of decibels is calculated as follows:

$$20 \lg \frac{(U_A)_A}{(U_A)_B} \text{ dB}$$

Note. – Cross-talk attenuations and separations are numerically equal only if:

$$(U_B)_A = (U_A)_B \text{ and } (U_A)_A = (U_B)_B$$

9. Acoustic characteristics

9.1 *Sound pressure level*

Twenty times the logarithm to base ten of the ratio of the sound pressure under consideration p to a reference sound pressure p_0.

The sound pressure level L_p, expressed in decibels, is calculated as follows:

$$L_p = 20 \lg \frac{p}{p_0}$$

The standard reference sound pressure p_0 is 20 μPa.

9.2 *Sound power level*

Ten times the logarithm to base ten of the ratio of the sound power under consideration P to a reference sound power P_{ref}. The sound power level L_P, expressed in decibels, is calculated as follows:

$$L_P = 10 \lg \frac{P}{P_{ref}} \text{ dB}$$

The standard reference sound power P_{ref} is 10^{-12} W (1 pW).

9.3 *Equivalent input sound pressure of a microphone*

The pressure of a reference sound field which would give rise to an output signal from the microphone, the r.m.s. value of which is equal to the r.m.s. value of a particular signal under consideration.

If not otherwise stated, the reference sound field shall be that due to a sinusoidal plane progressive wave, the wavefront being perpendicular to the reference axis of the microphone (zero angle of incidence). If weighting is used, this shall be stated.

10. **Polarity**

Polarity marking is the indication on an element giving the polarity relationship between the signal at the output terminals of the element and the signal at the input terminals.

A terminal of an electroacoustic transducer has positive polarity when:

a) an inward movement of a diaphragm resulting from an increase in external sound pressure (compression) produces a positive instantaneous voltage at that terminal, with respect to the other terminal;

b) a positive instantaneous voltage at that terminal produces an outward movement of a diaphragm.

For amplifiers, an arbitrary polarity choice has to be made either at the input or the output. This choice may be influenced by the design of connectors, some of which have pins that are normally associated with polarity conventions.

10.1 *Characteristics to be specified*

The manufacturer shall provide information concerning the polarity relationship between inputs and outputs. The polarity of an input shall be described either as "inverting" or "non-inverting" as appropriate. Inverting inputs should be suitably marked.

10.2 *Method of measurement*

a) A significantly asymmetric signal is connected to the input so as to produce an output voltage at a level convenient for observation on an oscilloscope.

b) The oscilloscope is transferred to the input terminals and the polarity relationship between output and input determined by inspection.

Notes 1. – The asymmetric signal is conveniently obtained by use of a diode to remove alternate half-waves of a sine-wave signal at 1 kHz.

2. – Where the input and/or output terminals are balanced, the oscilloscope requires a differential-input amplifier, or a suitable signal-isolating transformer may be used.

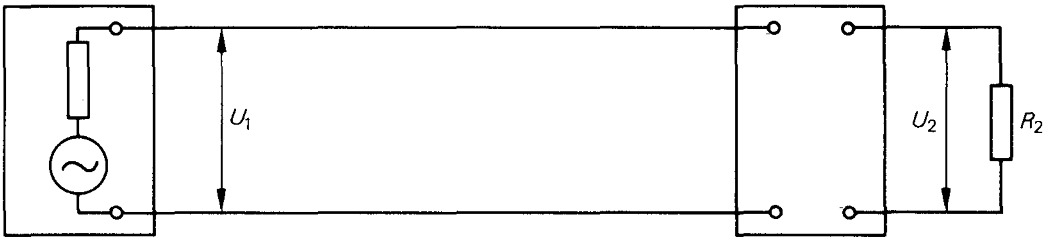
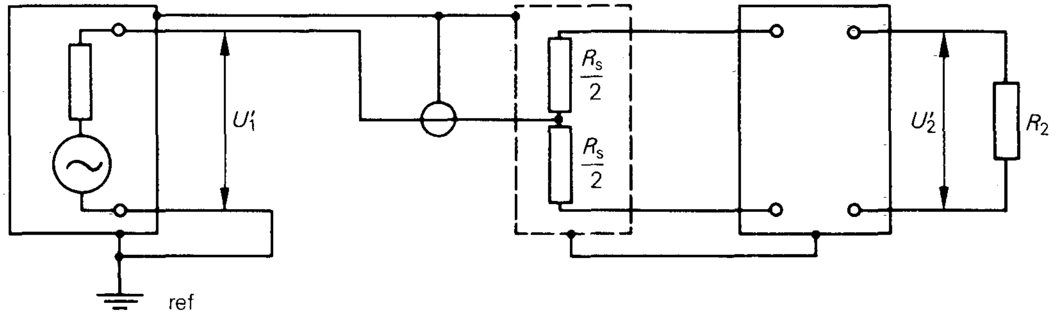


FIGURE 1a

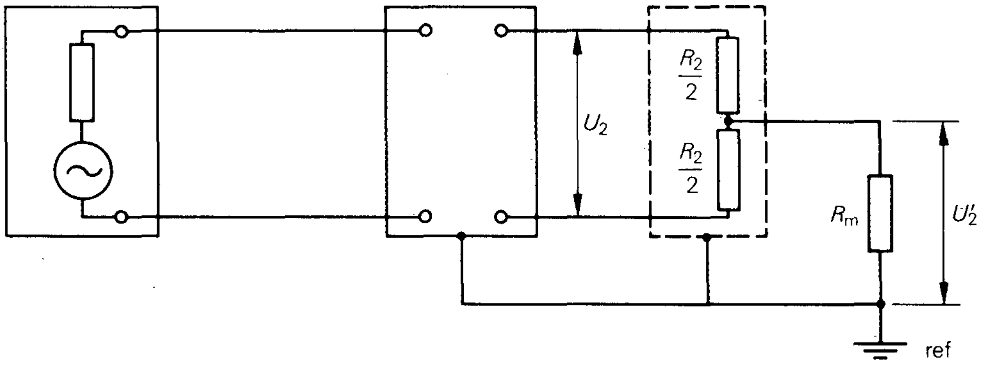


R_s is equal to the rated source impedance

FIGURE 1b

$$\text{Common-mode rejection ratio} = 20 \lg \left(\frac{U'_1}{U'_2} \times \frac{U_2}{U_1} \right) \text{ dB}$$

FIG. 1. – Balance of the input.



$$\text{Balanced-to-common-mode signal ratio} = 20 \lg \frac{U_2}{U'_2} \text{ dB}$$

Unless otherwise stated, the value R_m shall be 600 Ω and R_2 is equal to the rated load impedance.

Note. – If screened resistors, matched to the required degree of precision (and of suitable value and power rating) are not available, use may be made of a suitable balanced, centre tapped winding of an inductor or transformer (repeating coil). In this case the ends of the winding are connected in parallel with a resistor R_2 and the output terminals.

FIG. 2. – Balance of the output.

Harmonic distortion (Figure 3a)

Total harmonic distortion

$$d_t = \frac{\sqrt{U^2_{2(2f)} + U^2_{2(3f)} + U^2_{2(4f)} + \dots}}{U_2}$$

n^{th} harmonic distortion

$$d_n = \frac{U_{2(nf)}}{U_2}$$

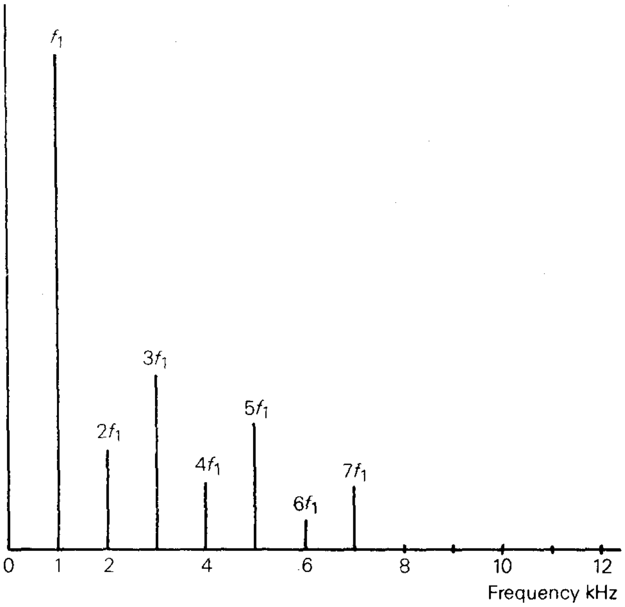


FIG. 3a. – Harmonic distortion.

Modulation distortion (Figure 3b)

If for instance,

$U_{2(f_1)} = 4U_{2(f_2)}$, then,

$U_{2_{ref}} = | U_{2(f_1)} | + | U_{2(f_2)} | = 5\,U_{2(f_2)}$

Second-order modulation distortion

$$d_{m2} = \frac{| U_{2(f_1 + f_2)} | + | U_{2(f_2 - f_1)} |}{U_{2(f_2)}}$$

Third-order modulation distortion

$$d_{m3} = \frac{| U_{2(f_2 - 2f_1)} | + | U_{2(f_2 + 2f_1)} |}{U_{2(f_2)}}$$

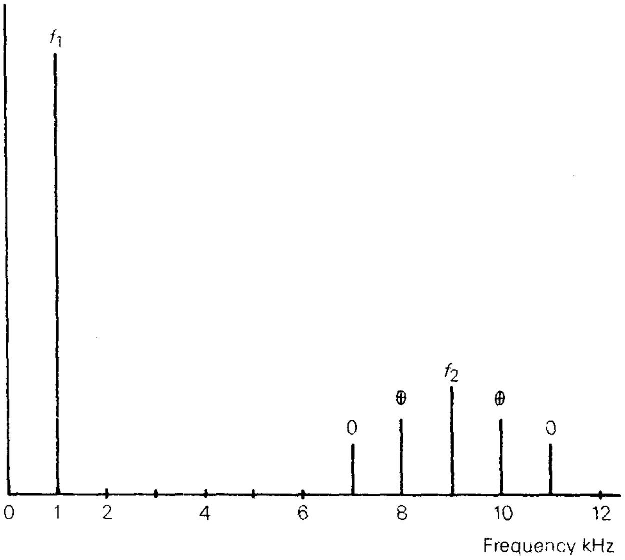


FIG. 3b. – Modulation distortion.

FIG. 3. – Distortion spectra.

Difference-frequency distortion (Figure 3c)

$$U_{2(f_1)} = U_{2(f_2)}$$

$$U_{2_{ref}} = | U_{2(f_1)} | + | U_{2(f_2)} | = 2\,U_{2(f_2)}$$

$f_2 - f_1 = 80$ Hz, for instance,

$fm = \dfrac{f_1 + f_2}{2}$ is a preferred ⅓-octave band centre frequency (for instance 10 kHz)

Second-order difference-frequency distortion

$$d_{d_2} = \frac{| U_{2(f_2 - f_1)} |}{2\,U_{2(f_2)}} = \frac{| U_{2(f_2 - f_1)} |}{U_{2_{ref}}}$$

Third-order difference-frequency distortion

$$d_{d_3} = \frac{| U_{2(2f_2 - f_1)} | + | U_{2(2f_1 - f_2)} |}{U_{2_{ref}}}$$

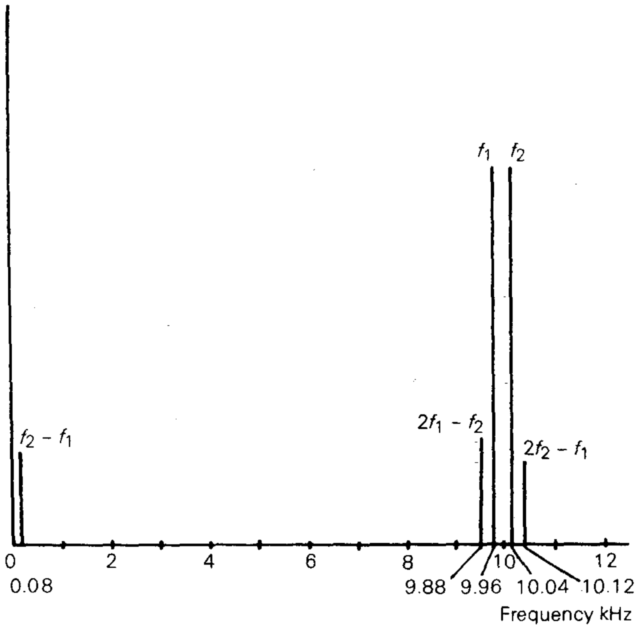


FIG. 3c. – Difference-frequency distortion.

Total difference-frequency distortion (Figure 3d)

$U_2(f_1) = U_2(f_2)$ with for instance:

$f_1 = 8$ kHz $\quad f_2 = 11.95$ kHz

$$U_{2_{ref}} = U_2(f_1) + U_2(f_2) = 2\,U_2(f_2)$$

$f' = f_2 - f_1 = 3.95$ kHz $\quad f'' = 2f_1 - f_2 = 4.05$ kHz

Total difference-frequency distortion:

$$d_{dtot} = \frac{\sqrt{(U_2')^2 + (U_2'')^2}}{U_{2\ ref}}$$

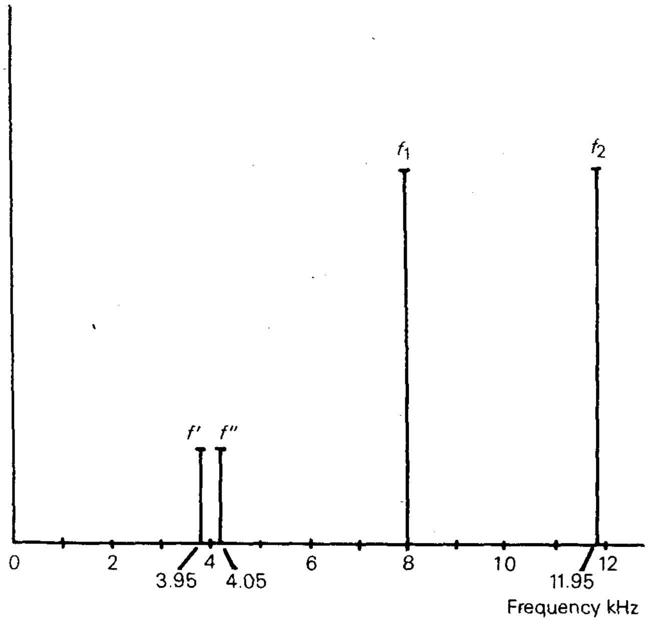


FIG. 3d. – Total difference-frequency distortion.

FIG. 3. – Distortion spectra.

AMENDMENT NO. 1

Page 8

7.2 *Explanation of terms*

Add a new item 12, page 9*, at the end of the existing item 11.*

12. *Weighted total harmonic distortion*

Is the total harmonic distorsion measured with the frequency weighting described in Clause A1 of Appendix A of IEC 268-1, allowance being made for the insertion loss of the weighting network at the input signal frequency. The total harmonic distortion may be measured directly or calculated as the r.m.s. sum of the weighted values of the individual harmonics.

Page 9

Replace the existing subclause 7.3.1 by the following new subclause 7.3.1:

7.3.1 *Usage of the various methods*

The simplest method of assessing amplitude non-linearity is the measurement of harmonic distortion using a sinusoidal signal. A disadvantage of this method is, however, that the nature of the sinusoidal signal is different in some respects from the nature of a real sound signal and the fact that the amplitudes of the harmonic distortion products of some devices (such as loudspeakers) vary considerably with frequency in an irregular manner.

This latter difficulty may be partly overcome by measuring the "noise distortion", where a noise signal instead of a sinusoidal signal is used.

When measurement of harmonic distortion is not appropriate, or when further information on distortion is called for, intermodulation distortion measurements using sinusoidal or noise signals may be made.

Weighted total harmonic distortion measurements are useful when the harmonic distortion consists of many harmonics, all of low level relative to that of the total output voltage.

In such a case, the results of weighted measurements correlate, better than those of unweighted measurements, with subjective assessments of quality of reproduction (listening tests).

Except in the above case, unweighted measurements are preferred.

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